

PATENT

Atty. Dkt. No. AMAT/3976.Y1/PPC/CMP/CKJM

IN THE CLAIMS:

Please amend the claims as follows:

1. (Previously Presented) A method of treating a substrate surface comprising copper or a copper alloy, the method comprising:
applying to the substrate surface a composition comprising:
one or more chelating agents, wherein the one or more chelating agents comprise an acid and a base;
one or more pH adjusting agents to produce a pH between about 3 and about 11;
deionized water; and
a reducing agent, wherein the reducing agent comprises between about 0.01 wt.% and about 20 wt.% of the composition; and then
applying a corrosion inhibitor solution.
2. (Currently Amended) The method according to claim 1, further comprising treating the substrate surface with a the corrosion inhibitor solution prior to ~~treating the~~ applying to the substrate surface with the composition.
3. (Original) The method according to claim 2, wherein the corrosion inhibitor solution comprises between about 0.01 wt.% and about 0.50 wt.% corrosion inhibitor and deionized water.
4. (Original) The method according to claim 3, wherein the corrosion inhibitor is selected from the group consisting of benzotriazole, 5-methyl-1-benzotriazole, and combinations thereof.
5. (Cancelled)

PATENT

Atty. Dkt. No. AMAT/3978.Y1/PPC/CMP/CKIM

6. (Currently Amended) The method according to claim 1, wherein the one or more chelating agents comprising an acid and a base has a an acid concentration of up to about 40 wt.% of the composition.
7. (Original) The method according to claim 6, wherein the acid is a carboxylic acid having one or more acid groups.
8. (Original) The method according to claim 7, wherein the acid is selected from the group consisting of acetic acid, citric acid, maleic acid, and combinations thereof.
9. (Currently Amended) The method according to claim 1, wherein the one or more chelating agents comprising an acid and a base has a base concentration up to about 5 wt.% of the composition.
10. (Original) The method according to claim 1, wherein the base comprises between about 0.5 wt.% and about 3 wt.% of the composition.
11. (Original) The method according to claim 9, wherein the base is selected from the group consisting of ammonium hydroxide, ammonium hydroxide derivatives, amines, and combinations thereof.
12. (Original) The method according to claim 1, wherein the composition further comprises a corrosion inhibitor.
13. (Currently Amended) The method according to claim 12, wherein the corrosion inhibitor in the composition comprises between about 0.01 wt.% and about 0.50 wt.% of the composition.
14. (Currently Amended) The method according to claim 12, wherein the corrosion inhibitor in the composition is selected from the group consisting of benzotriazole, 5-methyl-1-benzotriazole, and combinations thereof.

PATENT

Atty. Dkt. No. AMAT/3976.Y1/PPC/CMP/CKIM

15. (Canceled)

16. (Currently Amended) The method according to claim 1, wherein the composition has a pH between about 4 and about 5 and comprises between about 5 wt.% and about 30 wt.% citric acid, and between about 0.5 wt.% and about 3.0 wt.% ammonium hydroxide.

17. (Currently Amended) The method according to claim 2, wherein the treating the substrate surface with the corrosion inhibitor solution ~~is applied prior to treating the substrate surface with the composition for between~~ lasts about 3 and about 10 seconds.

18. (Original) The method according to claim 1, wherein the composition is applied between about 10 and about 20 seconds.

19-20. (Canceled)

21. (Previously Presented) A method of treating a substrate surface comprising copper or a copper alloy, the method comprising:

applying to the substrate surface a composition comprising:

one or more chelating agents, wherein the one or more chelating agents comprise an acid and a base;

one or more pH adjusting agents to produce a pH between about 3 and about 11;

a reducing agent wherein the reducing agent is selected from the group consisting of hydroxylamine, glucose, sulfathionate, potassium iodide, and combinations thereof; and

deionized water; and then

applying a corrosion inhibitor solution.

PATENT

Atty. Dkt. No. AMAT/3976.Y1/PPC/CMP/CKIM

22. (Currently Amended) The method according to claim 1, wherein the corrosion inhibitor solution comprises between about 0.01 wt.% and about 0.50 wt.% corrosion inhibitor and deionized water.

23. (Original) The method according to claim 22, wherein the corrosion inhibitor is selected from the group consisting of benzotriazole, 5-methyl-1-benzotriazole, and combinations thereof.

24. (Original) The method according to claim 22, wherein the corrosion inhibitor solution is applied between about 3 and about 10 seconds.

25. (Currently Amended) The method according to claim 1, wherein the one or more pH adjusting agents are selected from the group consisting of a ~~non-oxidating~~ nonoxidizing inorganic acid, a ~~non-oxidating~~ nonoxidizing organic acid, a ~~non-oxidating~~ nonoxidizing inorganic base, a ~~non-oxidating~~ nonoxidizing organic base, and combinations thereof.

26. (Original) The method according to claim 1, wherein the one or more pH adjusting agents comprise an acidic chelating agent, a basic chelating agent or a combination thereof.

27. (Previously Presented) A method of planarizing a substrate surface containing an dielectric layer having an upper surface and at least one opening, a barrier layer lining the opening and the upper surface of the dielectric layer, and copper or a copper alloy filling the opening and on the dielectric layer, the method comprising:

removing the copper or copper alloy layer and the barrier leaving an exposed substrate surface comprising copper or copper alloy in the opening; and

treating the exposed substrate surface comprising copper or the copper alloy by applying thereto a composition comprising

one or more chelating agents,

PATENT

Atty. Dkt. No. AMAT/3976.Y1/PPC/CMP/CKIM

one or more pH adjusting agents to produce a pH between about 3 and about 11, and

deionized water, wherein the one or more chelating agents comprise an acid and a base and wherein the composition further comprises a reducing agent, wherein the reducing agent comprises between about 0.01 wt.% and about 20 wt.% of the composition; and then

applying a corrosion inhibitor solution.

28. (Original) The method according to claim 27, further comprising removing the barrier layer after removing the copper or copper alloy layer and prior to chemically treating the exposed substrate surface.

29. (Original) The method according to claim 27, wherein removing the copper or the copper alloy layer comprises chemical-mechanical polishing (CMP) the copper or the copper alloy layer.

30. (Original) The method according to claim 29, wherein the method comprises:
removing the copper or copper alloy layer and stopping on the barrier layer;
removing the barrier layer and leaving the exposed substrate surface comprising copper or copper alloy features.

31. (Original) The method according to claim 27, wherein:
the dielectric layer comprises a silicon oxide; and
the barrier layer comprises tantalum (Ta) or tantalum nitride (Ta_N).

32. (Original) The method according to claim 27, wherein the method comprises chemically treating the exposed substrate surface comprising copper or the copper alloy layer to remove a portion of the substrate surface of the copper or copper alloy or to remove corrosion stains from the copper or copper alloy substrate surface.

PATENT

Atty. Dkt. No. AMAT/3976.Y1/PPC/CMP/CKIM

33. (Original) The method according to claim 32, wherein the method comprises chemically removing up to about 50Å from the exposed substrate surface comprising copper or the copper alloy.
34. (Currently Amended) The method according to claim 27, further comprising treating the substrate surface with a the corrosion inhibitor solution prior to applying the composition.
35. (Original) The method according to claim 27, wherein the composition comprises deionized water, citric acid and ammonium hydroxide.
36. (Currently Amended) The method according to claim 27, wherein the method comprises:
mounting the substrate on a carrier in a CMP apparatus;
CMP the substrate using a polishing pad;
performing the initial treating step the exposed substrate surface;
applying the composition; and
applying the corrosion inhibitor solution while separating the substrate from the polishing pad.
37. (Original) The method according to claim 34, wherein the corrosion inhibitor solution comprises between about 0.01 wt.% and about 0.50 wt.% corrosion inhibitor and deionized water.
38. (Original) The method according to claim 37, wherein the corrosion inhibitor is selected from the group consisting of benzotriazole, 5-methyl-1-benzotriazole, and combinations thereof.
39. (Cancelled)

PATENT

Any. Dkt. No. AMAT/3976.Y1/PPC/CMP/CKIM

40. (Currently Amended) The method according to claim 27, wherein the one or more chelating agents comprising an acid and a base has a an acid concentration of up to about 40 wt.% of the composition.
41. (Original) The method according to claim 40, wherein the acid is a carboxylic acid having one or more acid groups.
42. (Original) The method according to claim 41, wherein the acid is selected from the group consisting of acetic acid, citric acid, maleic acid, and combinations thereof.
43. (Original) The method according to claim 27, wherein the base comprises up to about 5 wt.% of the composition.
44. (Original) The method according to claim 43, wherein the base comprises between about 0.5 wt.% and about 3 wt.% of the composition.
45. (Original) The method according to claim 43, wherein the base is selected from the group consisting of ammonium hydroxide, ammonium hydroxide derivatives, amines, and combinations thereof.
46. (Original) The method according to claim 27, wherein the composition further comprises a corrosion inhibitor.
47. (Currently Amended) The method according to claim 46, wherein the corrosion inhibitor in the composition comprises between about 0.01 wt.% and about 0.50 wt.% of the composition.
48. (Currently Amended) The method according to claim 46, wherein the corrosion inhibitor in the composition is selected from the group consisting of benzotriazole, 5-methyl-1-benzotriazole, and combinations thereof.

PATENT

Atty. Dkt. No. AMAT/9976.Y1/PPC/CMP/CKIM

49. (Canceled)

50. (Currently Amended) The method according to claim 49 ~~27~~, wherein the composition has a pH between about 4 and about 5 and comprises between about 5 wt.% and about 30 wt.% citric acid, and between about 0.5 and about 3.0 wt.% ammonium hydroxide.

51. (Currently Amended) The method according to claim 34, wherein the treating the substrate surface with the corrosion inhibitor solution is applied between ~~lasts~~ about 3 and about 10 seconds ~~prior to treating the substrate surface with the composition.~~

52. (Original) The method according to claim 27, wherein the composition is applied between about 10 and about 20 seconds.

53. (Original) The method according to claim 34, wherein the corrosion inhibitor solution comprises between about 0.01 wt.% and about 0.50 wt.% corrosion inhibitor and deionized water.

54. (Original) The method according to claim 34, wherein the corrosion inhibitor is selected from the group consisting of benzotriazole, 5-methyl-1-benzotriazole, and combinations thereof.

55. (Original) The method according to claim 27, wherein the corrosion inhibitor solution is applied between about 3 and about 10 seconds.

56. (Currently Amended) The method according to claim 27, wherein the pH adjusting agent is selected from the group consisting of a ~~non-oxidating~~ nonoxidizing inorganic acid, a ~~non-oxidating~~ nonoxidizing organic acid, a ~~non-oxidating~~ nonoxidizing inorganic base, a ~~non-oxidating~~ nonoxidizing organic base, and combinations thereof.

PATENT

Atty. Dkt. No. AMAT/3978.Y1/PPC/CMP/CKIM

57. (Original) The method according to claim 27, wherein the one or more pH adjusting agents comprise an acidic chelating agent, a basic chelating agent or a combination thereof.

58-59. (Canceled)

60. (Previously Presented) A method of planarizing a substrate surface containing a dielectric layer having an upper surface and at least one opening, a barrier layer lining the opening and the upper surface of the dielectric layer, and copper or a copper alloy filling the opening on the dielectric layer, the method comprising:

removing the copper or copper alloy layer and the barrier leaving an exposed substrate surface comprising copper or copper alloy in the opening; and

treating the exposed substrate surface comprising copper or the copper alloy by applying thereto a composition comprising one or more chelating agents, one or more pH adjusting agents to produce a pH between about 3 and about 11, a reducing agent, and deionized water, wherein the one or more chelating agents comprise an acid and a base and wherein the reducing agent is selected from the group consisting of hydroxylamine, glucose, sulfathionate, potassium iodide, and combinations thereof; and then applying a corrosion inhibitor solution.

61. (Previously Presented) A method of treating a substrate surface comprising copper or a copper alloy, the method comprising:

applying to the substrate surface a composition comprising:

one or more chelating agents, wherein the one or more chelating agents comprise an acid and a base;

one or more pH adjusting agents to produce a pH between about 3 and about 11; and

deionized water; and then

applying a corrosion inhibitor solution, wherein the composition comprises about 26 wt.% citric acid, about 3 wt.% ammonia, deionized water, and a pH of about 4.

PATENT

Atty. Dkt. No. AMAT/3976.Y1/PPC/CMP/CKIM

62. (Previously Presented) A method of planarizing a substrate surface containing an dielectric layer having an upper surface and at least one opening, a barrier layer lining the opening and the upper surface of the dielectric layer, and copper or a copper alloy filling the opening and on the dielectric layer, the method comprising:

removing the copper or copper alloy layer and the barrier leaving an exposed substrate surface comprising copper or copper alloy in the opening; and

treating the exposed substrate surface comprising copper or the copper alloy by applying thereto a composition comprising one or more chelating agents, one or more pH adjusting agents to produce a pH between about 3 and about 11, and deionized water, wherein the one or more chelating agents comprise an acid and a base; and then

applying a corrosion inhibitor solution, wherein the composition comprises about 26 wt.% citric acid, about 3 wt.% ammonia, deionized water, and a pH of about 4.